

**Foster Dam Fall Spill Injunction Measure
2021-08-20**

Description/Intent

On July 14, 2021, the U.S. District Court for the District of Oregon issued a draft Interim Injunction Order that, once finalized, will direct the Corps to implement specified operations intended to improve conditions for fish passage and water quality in the Willamette Valley Project (WVP) to avoid irreparable harm to Endangered Species Act (ESA) - listed salmonids during the interim period until the completion of the reinitiated ESA consultation. These measures must be carried out “to the greatest extent practicable under existing hydrologic conditions and necessary flood control operations” while making “every effort to comply with the various water temperature, Total Dissolved Gas (TDG) and instream flow requirements governing WVP.”

The Draft Order requires the Corps will conduct/prioritize spillway operations at Foster Dam during the fall for juvenile fish passage, beginning in the fall of 2021.

The Court assigned an Expert Panel comprised of two of Plaintiffs’ experts, two NMFS biologists, two Corps employees, and two “ad hoc” Federal experts to define the details of this and other measures. The Expert Panel Assignment for the Foster spill operation is to “Consider and propose measures specifying the dates, hours, and amount of turbine use for the Foster spill operations that will provide the most benefit to the listed salmonids as a whole.”

The Expert Panel has considered multiple factors in developing this implementation plan.

- First, what is/are the biological objective(s) or goal(s) being sought and how can these objectives best be achieved?
- Second, what are the constraints or factors that need to be considered?
- And third, what additional information should be considered when shaping the operation?

Biological Goal

The goal of this spill operation measure is to provide improved downstream fish passage and survival for juvenile spring Chinook salmon and steelhead through Foster Reservoir and past Foster Dam. Through biological studies (or Research, Monitoring and Evaluation, RM&E) over the last several years, regional biologists have learned that fish tend to:

- exit Foster Reservoir mostly at night;
- pass in higher numbers via the spillway compared to the turbines; and
- survive at greater numbers when passed through the spillway than through the powerhouse and turbines.

Several years of RM&E of downstream fish passage timing and distribution indicate 96-98% Chinook salmon and steelhead pass Foster Dam at night and very few fish pass during daylight hours (Hughes et al 2016, 2017; Liss et al 2020). Additionally, approximately 58% of fish pass the spillway compared to 20% passage through the turbines, and survival rates were higher at the spillway (68%) compared to the turbines (57%) (Hughes et al 2016, 2017; Liss et al 2020).

Research conducted from 2016 through 2017 to evaluate the influence of Foster operations (turbine and spill) on river environment and fish habitat downstream of the dam indicate TDG levels in the river were highest (exceeding 110%) during periods when the spillway was operated by itself (i.e., with no turbine operation) (Arntzen et al 2018). However, TDG levels decreased (less than 110%) during periods of spillway and turbine operations (turbines were operated at 200 cfs for Station Service only) (Arntzen et al 2018). The TDG levels, even when they exceeded 110% saturation for short durations, did not appear to affect adult and juvenile salmon in the river (Arntzen et al 2018).

The proposed timing of the fall spill operations are based on research conducted to evaluate downstream fish passage and downstream TDG levels at Foster Dam.

Fall Spill Operation dates: October 01 through December 15.

Total project outflow is dependent on project storage and water availability. At this time, it is unknown whether there will be adequate stored water to meet spawning flow targets of 1500 cfs, from September 01 – October 15. To date, the 2021 water year has been dry and is considered a deficit year so project storage is unseasonably low for many Willamette Reservoirs, including Green Peter Reservoir, which helps to provide flow to the South Santiam River downstream of Foster Dam. If dry conditions persist this fall, adaptive management will be necessary and adjustments to total project outflows and this spill operation may be necessary. A balance between downstream river conditions and reservoir storage (i.e., the Green Peter power pool) is critical. Current forecasts indicate that an initial spawning flow of 1,100 cfs (from Sept 1 – 07), with a ramp up to 1300 cfs (after Sept 07). 1100 cfs would provide adult Chinook salmon access to most of the spawning gravel downstream of Foster Dam and would lessen the chance of de-watering redds during incubation. If funding and staffing allow, spawning survey(s) will be conducted from Foster to Pleasant Valley if flow is at or below 1,100 cfs.

Starting just after Labor Day weekend, Foster Reservoir will be gradually drawn down to target a forebay elevation of 620-625 ft. by October 01. Beginning on October 01, the following spill priorities will be followed:

- The Foster spillway will be operated from one hour before sunset to one-half hour after sunrise; turbine unit 1 (only) will be operated at station service (~300 cfs) to reduce/balance TDG levels created by the spill operation. Spill gates should be opened to a 1 ft. gate opening; outflow amounts will be dictated by reservoir

elevation (Table 1). Flows will be spread across multiple gates if necessary.¹ The fish ladder will continue to be operated.

- During the day, the Foster turbine units will be operated from one-half hour after sunrise to one hour before sunset, with full generation. The spillway will not be used to discharge water during this time unless required for flood risk management. The fish ladder will continue to be operated.

Table 1. Foster Dam Spillway Rating Table, 1 ft. Gate Opening.

Elevation, in ft. NGVD29	Flow at a 1ft. Gate Opening, in cfs
615	910
620	1020
625	1110
630	1210
635	1290
637	1320

The Corps' TDG model for Foster Dam predicts that spillway flows in excess of 3,000 cfs will generate TDG that exceeds the 110% water quality standard. This, and other water quality conditions will be monitored, and flows will be adjusted accordingly throughout this fish passage operation. The Corps will make every effort to comply with the State water quality standards.

Constraints and Considerations

This plan considers both the constraints that must not be violated, as well as other considerations such as current hydrologic conditions, etc. While implementing the fall spill operation at Foster Dam, the following constraints must be adhered to at all times:

- a. In general, spillway operations are known to produce TDG in exceedance of 110%. However, RM&E indicates operating turbine unit 1 at Station Service will reduce/balance TDG levels in the tailrace and downstream of Foster Dam during this fish passage operation. If higher outflows are required due to high inflow events, spill operations can be increased to as much as 3,000 cfs; higher spillway releases should be avoided to keep TDG levels downstream of Foster Dam below 110%.
- b. The spillway gates should not be operated at less than 1 foot open.

¹ Spreading spill across multiple gates reduces TDG generation. However, spillway passage survival tends to be highest at higher gate openings. These and other issues associated with spill operations were considered in developing this plan.

- c. The Corps' flood control mission is prioritized over all other actions and at no time will human health or safety be jeopardized during the implementation of this measure.

In addition to the constraints, the following considerations were used to develop the Foster Spill operations implementation plan:

- a. The BiOp minimum flow target for salmon and steelhead spawning and incubation downstream of Foster Dam is 1,100 cfs from October 16 to January 31.
- b. Fish passage through Foster Dam occurs at night with few, if any, fish passing during daylight hours.
- c. The Foster Adult Fish Facility is typically operated from February through November. The side entrance of the fishway (ladder) is adjacent to the spillway and spill could attract adult fish to the spillway instead of the ladder entrance. Additional flow to the ladder area may reduce this problem.
- d. Larger spillway gate openings provide safer passage and are more protective for fish.
- e. Use of Green Peter power pool storage to meet downstream flow benefits was coordinated through the Flow Management and Water Quality Team (FMWQT) when drought conditions were recognized early.

Implementation Plan

Taking the biological goal, RM&E conducted to date, constraints, and considerations described above into account, this implementation plan has been developed for the Foster Dam fall spill operations Injunction Measure, with the fall spill operation commencing on October 01, 2021. Note, the spill operation is tied to the hydrologic conditions of each year; that is, the total flow amount and timing (dates) of the start and end of the spill operations each season and year. These conditions could change depending on hydrologic conditions (water availability). What will not change from year to year is the overall goal of the operation and the constraints, which is to operate the spillway in the fall for downstream fish passage.

Potential Impacts and Mitigation

Spillway operations can create high TDG levels downstream of Foster Dam; that is TDG levels that violate the State water quality standard of 110%. Therefore, it is imperative to operate one turbine unit (Unit 1) at Station Service during spill operations to reduce/balance the TDG levels downstream of the dam.

Per Dam Safety requirements: Spill should be split evenly between two spill bays (e.g., bays 3 and 4) as long as a minimum gate opening of 1.0 foot can be obtained for each bay. If a 1-foot opening cannot be maintained using two bays, a single spill bay will be used, alternating daily between bays 2, 3, and 4. Spill bays 2-4 should be used for passing flows above 4,000 cfs through the spillway. All spill bays would be used for passing flows above 12,000 cfs.

Biological Monitoring

The following was developed to address the goal of the Draft Order to “provide meaningful research, monitoring, and evaluation (“RM&E”) of the interim measures”. RM&E for the fall 2021 spill operation was developed on a very short timeline and therefore may not be as robust as in a more developed plan. However, the objective of this RM&E is to learn as much as possible from the fall 2021 operations to inform not only this year’s operation, but outyear operations as well. In addition, because of the short timeframe to submit this plan, a more detailed RM&E plan will be prepared by the Expert Panel later this fall or early 2022 that would address the fall spill operations in 2022 and beyond. The plan may include RM&E for site-specific passage and survival and a plan for developing and implementing detection infrastructure for conducting studies using large release groups (e.g., detection at Foster and Lebanon dams). The plan may also include studies involving juvenile salmonids collected upstream of Foster Dam.

The metrics of interest include juvenile Chinook salmon and steelhead passage timing, forebay behavior and distribution, route distribution, passage rates and passage survival. The following outline the metrics that could possibly be evaluated during this fall spill operation. Active tag (radio telemetry) technology is recommended to evaluate these metrics because active tags will provide precise information on route distribution, passage rates, and survival. Additionally, active tag studies were conducted at Foster during 2015 through 2019 to evaluate spillway and turbine passage and survival rates and the results from those studies can be used to compare to the results of studies conducted to evaluate the fall spill injunction operation. However, long-term survival and studies such as paired-releases would require use of PIT tags because of large sample sizes required to obtain robust estimates. In addition, PIT tags can be used on small fish, either naturally produced juveniles (such as fish entering the reservoir) or surrogate fish that approximate the size of naturally produced fish. Appropriate methodology will be identified when a long-term RM&E strategy is developed as noted below.

Of note, it is not feasible to use screw traps in the tailrace of Foster Dam because the river environment is shallow. There is only one potential location for a screw trap in the tailrace, which is directly downstream of the powerhouse (turbine unit 1), close to the shore. Oregon Department of Fish and Wildlife operated a screw trap downstream of the turbine, close to shore, during 2015 and 2016 and determined the trap efficiency was very poor and removed the screw trap from operation (Romer et al 2016).

Due to the short timeline to implement the Foster fall spill measure and the lack of tag detection infrastructure, RM&E will be constrained in 2021, composed primarily of developing a fish-passage data collection system plan, and monitoring water quality and flow. The RM&E activities to evaluate the fall 2021 spill operation are as follows:

- A. If funding and staffing allow, spawning survey(s) will be conducted from Foster to Pleasant Valley if flow is at or below 1,100 cfs. These surveys will be conducted to

- verify location of redds and depth of water over shallow redds. ODFW does not have funding or staff in place to conduct surveys in South Santiam.
- B. The Corps will initiate discussions by September 1 with the City of Albany (the owner of Lebanon Dam) regarding installing a new PIT-tag detection system at Lebanon Dam, to be installed as soon as possible.
 - C. Surrogate fish (hatchery fish raised to mimic the size of fish likely to pass Foster Dam) will be needed to conduct studies requiring releases of large numbers of fish (e.g., outmigration and survival), not just for Foster studies but also for Green Peter passage studies. The Corps, or its designee, will collect eggs from returning Chinook adults during fall 2021, and have them raised to the sizes needed to conduct passage survival studies using surrogate fish in 2022.²

Hydropower Impacts

BPA expects hydropower impacts to be similar to past Foster Fall Spill operations.

Transmission Impacts

Assuming that operational changes for this operation only occur at Foster, then there should be minimal impacts to the transmission system.

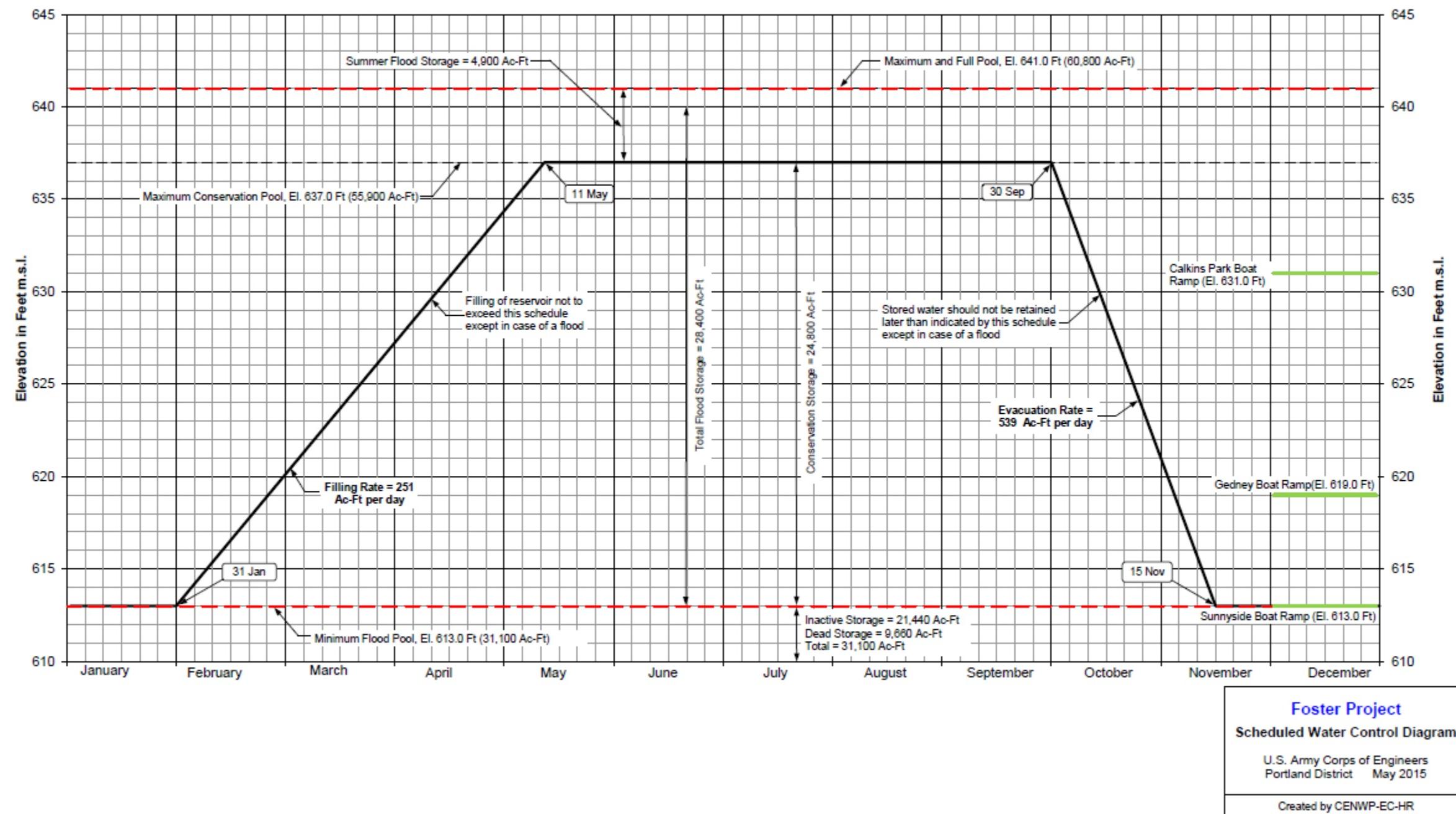
At this time, it is unknown whether there will be adequate stored water to meet spawning flow targets of 1500 cfs, from September 01 – October 15. To date, the 2021 water year has been dry and is considered a deficit year, so project storage is unseasonably low for many Willamette Reservoirs, including Green Peter Reservoir, which helps to provide flow to the South Santiam River downstream of Foster Dam. If dry conditions persist this fall, adaptive management will be necessary and adjustments to total project outflows and this spill operation may be necessary. A balance between downstream river conditions and reservoir storage (i.e., the Green Peter power pool) is critical.

In the event that Green Peter Reservoir is drawn down below the minimum power pool elevation to meet flow targets in this dry year, and there is no generation at Green Peter, then there would likely be some impacts to the transmission system. BPA will need to be well informed of the timing and duration of any dip beneath the power pool at Green Peter to analyze the transmission impact.

Irrigation Impacts

Any action that substantially reduces summer storage or releases could affect irrigation water service contractors and water rights.

² Surrogate two-year old winter steelhead will not be available in 2023; eggs were not collected in 2021 due to low populations of returning adults.

Figure 1. Foster Reservoir Water Control Diagram

References

- Arntzen EV, RJ Flaherty, AH Colotel, RA Harnish, J Varrinec, SA Zimmerman, JD Tagesstad, and K Sertz. 2018. *Assessment of the Effects of Total Dissolved Gas Exposure of Upper Willamette River Chinook Salmon and Steelhead Below Foster Dam*. PNNL-27325. Final report submitted by the Pacific Northwest National Laboratory to the U.S. Army Corps of Engineers, Portland, Oregon.
- Hughes JS, BJ Bellgraph, J Kim, CV Vernon, EF Fischer, ED Green, SA Liss, KA Deters, and GE Johnson. 2016. *Evaluation of Juvenile Salmonid Passage and Behavior at Foster Dam Using Radio Telemetry, 2015*. PNNL-25253. Final report submitted by the Pacific Northwest National Laboratory to the U.S. Army Corps of Engineers, Portland, Oregon.
- Hughes JS, SA Liss, RJ Flaherty, ES Fischer, BJ Bellgraph, CV Vernon, and GE Johnson. 2017. *Evaluation of Juvenile Salmonid Passage and Behavior at Foster Dam Using Radio Telemetry, 2016*. PNNL-26416. Final report submitted by the Pacific Northwest National Laboratory to the U.S. Army Corps of Engineers, Portland, Oregon.
- Liss SA, KR Znotinas, JS Hughes, BJ Bellgraph, CR Vernon, RA Harnish, ES Fischer, and SE Blackburn. 2020. *Evaluation of Foster Dam Juvenile Fish Passage, 2018*. PNNL-29587. Final report submitted by the Pacific Northwest National Laboratory to the U.S. Army Corps of Engineers, Portland, Oregon.
- Romer JD, FR Monzyk, R Emig, and TA Friesen. 2016. *Juvenile Salmonid Outmigration Monitoring at Willamette Valley Project Reservoirs*. Annual report for 2015 submitted to the U.S. Army Corps of Engineers, Portland District, Portland, Oregon, by the Oregon Department of Fish and Wildlife, Corvallis, Oregon.